

TITLE OF THE INVENTION
EXPANSION UNIT AND ELECTRONIC-APPARATUS SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is based upon and claims the
5 benefit of priority from the prior Japanese Patent
Application No. 2002-190895, filed June 28, 2002, the
entire contents of which are incorporated herein by
reference.

BACKGROUND OF THE INVENTION

10 1. Field of the Invention

The present invention relates to an expansion unit
for expanding the function of portable electronic
apparatus such as a personal digital assistant (PDA)
and an electronic-apparatus system including the
15 expansion unit and electronic apparatus. More
specifically, the invention relates to an expansion
unit and an electronic-apparatus system, which decrease
the number of connectors through the shared use of a
connector for both data synchronization and function
20 expansion and which allow a plurality of expansion
units to be added in multiple stages through a single
connector with the connector available for data
synchronization.

2. Description of the Related Art

25 In recent years, battery-operable portable
electronic apparatus such as a PDA has become
widespread. In general, the main body of this type of

electronic apparatus has only the fundamental function to prevent its portability from deteriorating and an expansion unit for expanding the function can be connected to the electronic apparatus when the need
5 arises.

For example, in the electronic apparatus disclosed in Jpn. Pat. Appln. KOKAI Publication No. 6-195153, a plurality of option modules can be connected through a single additionally optional connector by connecting
10 the option modules in series to the additionally optional connector. According to this apparatus, even though a number of expansion options are mounted, a number of connectors need not be provided and thus the electronic apparatus can be prevented from
15 increasing in size.

The above electronic apparatus always includes a connector for transmitting/receiving data to/from a so-called personal computer such as a desktop one and a notebook one. In order to downsize the electronic
20 apparatus further, recently, a connector for connecting signal lines for data synchronization and a connector for connecting signal lines for function expansion have been combined into one.

However, the above-described connector causes
25 a problem that one of transmission/reception of data to/from a personal computer and function expansion has only to be exclusively used. Furthermore, the above

Jpn. Pat. Appln. KOKAI Publication No. 6-195153 teaches connecting a plurality of expansion units to an additionally optional connector that is provided separately and does not have any concept of relaying
5 a data-synchronizing signal line that is not used for function expansion. If, therefore, the electronic apparatus of the Publication is adopted, a plurality of expansion units can be used simultaneously, but no data can be transmitted to or received from the personal
10 computer while the expansion units are connected.

BRIEF SUMMARY OF THE INVENTION

An embodiment of the present invention may provide an expansion unit and an electronic-apparatus system that allow a plurality of expansion units to be
15 connected in multiple stages through a single connector with the connector available for data synchronization.

According to an aspect of the invention, it provides an expansion unit that is detachably capable to be connected to electronic apparatus having a first
20 connector, comprising a second connector electrically connected to the first connector, a third connector whose shape is equal to that of the first connector and which is connected to other electronic apparatus being different from the electronic apparatus, and a signal
25 line which electrically connects the second connector and the third connector together.

The another aspect of the invention, it provides

an electronic-apparatus system comprising electronic apparatus and a first expansion unit detachably connected to the electronic apparatus, the electronic apparatus comprising a first connector used for both
5 data communications with other electronic apparatus and function expansion of the electronic apparatus, and the first expansion unit comprising a second connector electrically connected to the first connector, a third connector having a same shape as that of the first
10 connector and being connectable to the other electronic apparatus, and a first signal line which electrically connects the first connector and the second connector together.

Additional features and advantages of the
15 invention will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The features and advantages of the invention may be realized and obtained by means of the
20 instrumentalities and combinations particularly pointed out hereinafter.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The accompanying drawings, which are incorporated in and constitute a part of the specification,
25 illustrate embodiments of the invention, and together with the general description given above and the detailed description of the embodiments given below,

serve to explain the principles of the invention.

FIG. 1 is an external view of an electronic-apparatus system according to an embodiment of the present invention;

5 FIGS. 2A and 2B are diagrams each showing a connection mode of the electronic-apparatus system according to the embodiment of the present invention;

10 FIG. 3 is a diagram showing an example of a structure of signal lines formed in an expansion unit of the electronic-apparatus system shown in FIGS. 1 and 2A and 2B; and

FIG. 4 is a block diagram showing an example of use of the electronic-apparatus system according to the embodiment of the present invention.

15 DETAILED DESCRIPTION OF THE INVENTION

The embodiments of the present invention will be described below with reference to the drawings.

20 FIG. 1 is an external view of an electronic-apparatus system according to the embodiment of the present invention.

As shown in FIG. 1, the electronic-apparatus system includes a main device 10 that is called, for example, a PDA and an expansion unit 20 for expanding the function of the main device 10. An LCD 11 for displaying data and operating buttons 12 for inputting data are arranged as a user interface on the front of the main device 10. A connector 13 for connecting both

25

a data-synchronizing signal line and a function-expanding signal line to a personal computer is formed on the bottom of the main device 10. In other words, the connector 13 is a shared connector serving to
5 connect both the data-synchronizing signal line and the function-expanding signal line in order to reduce the number of connectors. Thus, the main device 10 is decreased in size and cost.

The expansion unit 20 includes a connector 22
10 having the same shape as that of the connector 13 of the main device 10 as well as a connector 21 that is fitted to the connector 13. In other words, another expansion unit 20 can be connected in series to the expansion unit 20. The expansion unit 20 includes
15 a group of signal lines for deriving a signal line, which is connected through the connector 21, from the connector 22. Thus, the main device 10 can transmit/receive data to/from a personal computer even though the expansion unit 20 is connected to the main
20 device 10.

The expansion unit 20 shown in FIG. 1 is used to add a function of displaying an image, which is displayed on the LCD 11, on an external display device such as a cathode ray tube (CRT). To do so,
25 a connector 23 for connecting the expansion unit 20 to the external display device through a cable is provided on one side of the expansion unit 20.

The area of the surface of the expansion unit 20 on which the connector 21 is provided is substantially the same as that of the bottom of the main device 10. Further, the width of the expansion unit 20 is
5 substantially the same as that of the main device 10 and so is the thickness.

FIGS. 2A and 2B are diagrams showing a connection mode of the electronic-apparatus system.

In FIGS. 2A and 2B, reference numeral 30 indicates
10 a cradle in which the main device 10 is held when data is transmitted to/received from a personal computer. Like the expansion unit 20, the cradle 30 has a connector 31 that is fitted into the connector 13 of the main device 10. Since the connector 22 of the
15 expansion unit 20 has the same shape as that of the connector 13 as described above, the connector 31 of the cradle 30 is also fitted into the connector 22.

In the electronic-apparatus system described above, a connector for connecting the data-
20 synchronizing signal line and a connector for connecting a function-expanding signal line are combined into a single shared connector (connector 13). However, the expansion unit 20 and cradle 30 can be used simultaneously, not exclusively or selectively.

25 FIG. 3 is a diagram showing an example of a structure of the group of signal lines formed in the expansion unit 20 shown in FIGS. 1 and 2A and 2B.

In FIG. 3, reference symbol a indicates a signal line for outputting display data to an external display device, which relays a line between the connectors 21 and 23. Reference symbol b denotes a signal line for data synchronization with a personal computer, which
5 relays a line between the connectors 21 and 22. Reference symbol c indicates, for example, a power supply line and other signal lines that relay a line between the connectors 21 and 22.

10 The signal line b relays a data-synchronizing signal line, which is derived from the main device 10, from the connector 21 of the expansion unit 20 to the connector 22 thereof; therefore, the expansion unit 20 can be used as shown in FIG. 4. In other words,
15 a function of increasing a memory capacity while data is being transmitted to/received from a personal computer 41 via the cradle 30 or a function of a global positioning system (GPS) for measuring the current position is added by the first expansion unit 20.

20 A function of displaying an image, which is displayed on the LCD 11, on an external display device 42 is added by the second expansion unit 20. Further, a function of inputting data through an external keyboard or gaining access to an external magnetic disk
25 drive (HDD) 44 is added by the third expansion unit 20.

As described above, the electronic-apparatus system reduces the number of connectors by the shared

use of a connector for both data synchronization and
function expansion and allows a plurality of expansion
units 20 to be added in multiple stages through
a single connector with the connector available for
5 data synchronization.

Additional advantages and modifications will
readily occur to those skilled in the art. Therefore,
the invention in its broader aspects is not limited to
the specific details and representative embodiments
10 shown and described herein. Accordingly, various
modifications may be made without departing from the
spirit or scope of the general inventive concept as
defined by the appended claims and their equivalents.